Citation:

St-Onge MP, Bourque C, Jones PJ, Ross R, Parsons WE. Medium- versus long-chain triglycerides for 27 days increases fat oxidation and energy expenditure without resulting in changes in body composition in overweight women. *Int J Obes Relat Metab Disord.* 2003 Jan;27(1):95-102.

PubMed ID: 12532160

Study Design:

Randomized Crossover Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine whether medium chain triglyceride (MCT), when compared to long chain triglyceride (LCT), consumption influences energy expenditure (EE) and substrate oxidation in overweight women consuming controlled diet, targeted to meet energy balance, rich in MCT or LCT for 27 days.

Inclusion Criteria:

- Seventeen healthy, obese women were recruited by advertisement.
- Subjects accepted into the study had plasma cholesterol and triglyceride concentrations below 7.0 mmol/l and 3.0 mmol/l respectively and were not taking cholesterol lowering drugs.
- Subjects did not have a history of cardiovascular disease, diabetes, gastrointestinal or thyroid problems.
- Subjects were required to be weight stable during the 3 months prior to recruitment and did not perform more than 5 exercise sessions per week.

Exclusion Criteria:

- Total cholesterol concentration greater than 7.0 mmol/l
- Triglyceride concentration greater than 3.0 mmol/l
- Taking cholesterol lowering medication
- History of cardiovascular disease, diabetes, gastrointestinal disorders or thyroid problems
- Instability of weight over the 3 months prior to recruitment
- Perform more than 5 exercise sessions per week

Description of Study Protocol:

Recruitment

Subjects recruited by advertisement.

Design

Randomized, crossover trial in which subjects became inpatients at the Mary Emily Clinical Nutrition Research Unit of McGill University for two phases of 27 days each.

Blinding used (if applicable): The use of blinding was not reported.

Intervention (if applicable)

- All meals were provided to subjects at the research unit via a 3 day cycle menu.
- Subjects consumed an amount of energy required to maintain weight as calculated using the Mifflin equation with an activity factor of 1.7.
- Diets contained 40% energy as fat, 15% energy as protein and 45% as carbohydrate.
- During the LCT phase of the trial, 75% of the fat was derived from either beef tallow or a blend of saturated and unsaturated vegetable oils.
- During the MCT phase of the trial, 50% of the total fat was provided by MCT oil, rich in octanoate and decanoate, 10% by olive oil and 5% by butter, coconut oil and flaxseed oil each.
- Subjects were randomly assigned to the MCT and LCT diet for the first experimental phase and consumed the alternate fat during the second phase.
- Both phases were separated by a 4 or 8 week washout period during which the subjects resumed their habitual lifestyles.

Statistical Analysis

- Analysis of variance was carried out using a model with diet, day, hour and sequence as factors in the model
- Paired student t-test was used to determine differences between diets at each hour on each individual day.
- Paired student t-test was also used to establish differences between MCT and LCT consumption on fecal fat excretion and changes in body composition.

Data Collection Summary:

Timing of Measurements

- Body weight measured daily before breakfast
- Body composition measured with magnetic resonance imaging (MRI) on days 1 and 28 of each experimental phase
- Energy expenditure was measured using a metabolic monitor (indirect calorimetry) for 30 minutes before breakfast and 30 minutes during every hour for 6 hours after breakfast on days 2 and 27 of each experimental phase
- Total fecal samples were collected for 3 days at mid-point through each experimental phase for determination of fecal fat excretion

Dependent Variables

- Changes in total and subcutaneous adipose tissue measured via MRI

- Average energy expenditure measured by indirect calorimetry
- Fat oxidation measured by indirect calorimetry
- Body weight measured daily
- Fecal fat excretion

Independent Variables

- High LCT or high MCT diet

Description of Actual Data Sample:

Initial N: 22 subjects (all female)

Attrition (final N): 17 subjects completed the study

Age: Average age 44.3 ± 3.8 years

Ethnicity: Canadian

Other relevant demographics: None reported

Anthropometrics

- Average weight 82.2 ± 2.7 kg
- Average height 160.6 ± 1.5 cm
- Average body mass index 31.8 ± 0.9 kg/m^2
- Average energy intake 2458 ± 73 kcal/day

Location:

Ste-Anne-de-Bellevue, Quebec, Canada

Summary of Results:

Key Findings:

- A decrease in body weight was measured within each dietary phase of the crossover trial, but no difference in weight loss was observed between the two phases (-0.87 ± 0.16 kg vs -0.84 ± 0.22 kg during the MCT and LCT consumption, respectively)
- No significant change was noted in total or subcutaneous adipose tissue volume during the consumption of a diet high in MCT or or a diet high in LCT
- Resting metabolic rate was not different between the two diet phases studied (0.84 ± 0.02 kcal/min vs 0.82 ± 0.03 kcal/min on day 2 of the MCT phase and LCT phase, respectively and 0.81 ± 0.03 kcal/min and 0.79 ± 0.02 kcal/min on day 27 of the MCT phase and LCT phase, respectively)
- Average energy expenditure was significantly greater during MCT than LCT consumption (0.95 ± 0.019 vs 0.90 ± 0.024 kcal/min, respectively; $P<0.05$)
- Average fat oxidation was significantly greater during the MCT than LCT consumption (0.080 ± 0.0026 vs 0.075 ± 0.0022 g/min, respectively; $P<0.05$)

Author Conclusion:

In conclusion, present results show that EE and fat oxidation are increased with MCT consumption compared to LCT consumption in healthy overweight women. Furthermore, raised levels of EE and fat oxidation remained consistently elevated during 27 days of consumption of a diet rich in MCT but were not associated with a detectable difference in effect on body fat depot size. Although it cannot be concluded that prolonged MCT consumption results in greater weight loss compared to LCT consumption, MCT intake resulted in increased EE and fat oxidation. This may promote long term weight maintenance in obese women.

Reviewer Comments:

- *The authors recognized that the amount of MCT provided by way of functional oils was much higher than would normally be consumed in the general population eating habitual diets increasing the concern that clinically significant changes in weight or adipose tissue volume would be found with recommendations to increase MCT consumption following a habitual diet.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	No

2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	???
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	???
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes

7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	Yes
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes